CITY OF BOSTON • MASSACHUSETTS

OFFICE OF THE MAYOR
THOMAS M. MENINO

April 24, 2009

To The City Council:

Dear Councillors;

In response to the 17F request filed by your Honorable Body on 2/25/09 re: cell phone antennas located in the City of Boston, please find the attached response.

Sincerely,

Thomas M. Menino

Thomas M. Menino
Mayor of Boston

April 7, 2009

Vincent Leo
Chief Engineer
Public Improvement Commission
Public Works Department
Room 714 City Hall
Boston, MA 02201

RE: Request for Information- Distributed Antenna System in the neighborhood of the Back Bay

Dear Mr. Leo,

In response to your request for information dated March 31, 2009 SBA Advanced Wireless Networks, LLC ("SBA AWN"), f/k/a Light Tower Wireless LLC, is pleased to provide the following responses:

1. List of all cell towers and antennas located in the City of Boston by:
    a. Owner:
    SBA Advanced Wireless Networks, LLC

    b. Carrier:
    MetroPCS

    c. Location(s):

Node ID	*Node Location*
BB-1	Northeast corner of Hereford St. & Marlborough St.
BB-2	Southwest corner of Commonwealth Ave. (Westbound) & Massachusetts Ave.
BB-3	Southwest corner of Massachusetts Ave. and Newbury St.
BB-4	Southwest corner of Gloucester St. & Beacon St.
BB-5	Southeast corner of Gloucester St. & Newbury St.
BB-6	East side of Fairfield St. between Marlborough St. & Alley 417
BB-7	Northeast corner of Fairfield St. & Boylston St.
BB-8	Northeast corner of Exeter St. & Beacon St.
BB-9	End of Dartmouth Street & Back Street (DCR Property)
BB-10	Northeast corner of Exeter St. & Newbury St.
BB-11	Northeast corner of Dartmouth St. & Newbury St.
BB-12	Southeast corner of Clarendon St. & Marlborough St.
BB-13	Southeast corner of Berkeley St. & Alley 422
BB-14	Southeast corner of Berkeley St. & Alley 438
BB-15	In traffic island at intersection of Arlington St. & Beacon St.
BB-16	Southwest corner of Arlington St. & Boylston St.
BB-17	Charlesgate East & Back Street (DCR Property)
BB-18	Charlesgate East & Newbury Street (DCR Property)

d. Date Installed:
The installation of SBA AWN's Distributed Antenna System in the Back Bay of Boston was completed in February of 2009.

e. Radio Frequency Power:
"The field measurements of the antenna array, run at the full 12 watt effective antenna power available at present, indicate that the antenna array is fully compliant with federal and state regulation of radio frequency emissions. The levels on the outside of the nearby building are, at the most, 1% of the applicable public safety requirements at the part of the building that is the very closest to the antenna array (8 feet away). In other words, even if there were one hundred antenna arrays operating in the same way on the lamppost (which is not physically possible), the emissions reaching the outside of the building 8 feet away would still be fully compliant with the safety regulations. Our computed emissions levels confirmed the field measurements."
Source: Evaluation of Human Exposure Potential To Radio Frequency Energy Of A Lamp-post-mounted Antenna Configuration Located in Back Bay, Boston and Operating in The Advanced Wireless Service Spectrum, dated 21 March 2009, Broadcast Signal Labs, Medfield, MA

f. Permitting Process for Installations:
SBA Advanced Wireless Networks, LLC adhered to all local approvals and processes, which included communicating and cooperating with multiple individuals and organizations, including the Public Improvement Commission, the Neighborhood Association of the Back Bay, the Back Bay Association, the Back Bay Architectural Commission, the State Department of Conservation and Recreation, as well as various community and elected officials, before we were allowed to proceed.

g. Compensation and Fees:
SBA Advanced Wireless Networks, LLC is contractually obligated to pay the City of Boston an annual revenue share as well as an annual fee per node. SBA Advanced Wireless Networks, LLC also is contractually obligated to compensate the Department of Conservation and Recreation an annual fee for those nodes located on their property.

h. Community Benefits:
The Distributed Antenna System located in the Back Bay of Boston brings the community many benefits including

- Improved cellular reception including public safety (E-911)
- Shared wireless infrastructure to mitigate proliferation of antennas; SBA AWN is neutral host to All carriers
- Revenue share and property tax revenue to the City
- SBA AWN is a local long-term partner
- Integral to carriers effort of providing low-cost wireless service to residents of Boston

Please do not hesitate to contact me directly, should you require any additional information.

Regards,

Chris Zack
General Manager
SBA Advanced Wireless Networks, LLC

NextG Networks®

EMPOWERING NEXT GENERATION WIRELESS NETWORKS

NextG Networks, Inc. 2216 O'Toole Avenue, San Jose, CA 95131 • Telephone 408.954.1580 • Fax 408.383.5397

General Public RF Exposure Levels from NextG Networks DAS Nodes

NextG Networks appreciates public concern regarding RF emissions from node locations in Boston. NextG is committed to fully complying with all FCC exposure requirements and to this end the nodes are designed to operate at very low power levels and are mounted at heights that make them inaccessible to the public.

To further verify compliance with the FCC maximum general-public exposure limits NextG requested an independent RF expert and licensed Professional Engineer, Julie Ann V. Schmitt PE, of CMX to analyze the node installations and prepare a report. The report describes several different scenarios and outlines the worst-case general-public exposure levels.

There are two of the specific, calculated values in the report that address most common concerns. Please note that the calculations are for the node transmitting at maximum power. It is relatively rare for a node to transmit at maximum power and for nodes where it this does occur it usually only happens for a portion of the day during peak node usage. During other times the transmit power, and thus the exposure level, will be less then the following examples.

Exposure Levels in Second Floor Room of Adjacent House
The first is the worst-case exposure for a person on the same horizontal level as the node antenna, such as a person standing in a second-story window at the same level as an antenna. This scenario is described in the last paragraph of page 5 and the first paragraph of page 6. According to the analysis, at two (2) feet horizontally from the antenna the maximum possible exposure level would be only 43% of the FCC limit for the general public (only levels over 100% exceed the FCC limit). This corresponds to a power density level of 0.43 mW/cm2 since the limit for frequencies above 1.5GHz is 1.0 mW/cm2. It is of course impossible for the general public to get within even two feet of the antenna when it is mounted on a utility pole so the exposure level within a second-story room at the same level would be far less.

Exposure Levels at Head Level Below Node
The second case is that of an individual walking around on the ground below a node antenna, and is described in the second-to-last paragraph of page 5. Because it would be wasteful to transmit energy straight down at the ground or straight up at the sky the node antennas are designed to direct most of the energy toward the horizon and away from the ground. The report specifies a worst-case exposure of no more then 1.72% of the FCC limit for the general public, which occurs fifty-five (55) feet horizontally from the node (all other areas under and around the node are even less). This corresponds to a power density level of 0.0172 mW/cm2.

The report describes additional scenarios and calculations for different installation styles that would produce even lower exposure levels around the node. A thorough review of the report will reveal that there are no locations around the node where the public could be exposed to levels that exceed the very conservative FCC limit for exposure.

Maximum Permissible Exposure (MPE) Calculations for NextG Networks

August 11, 2008

TABLE OF CONTENTS

Executive Summary

On behalf of NextG Networks, we have performed Maximum Permissible Exposure (MPE) Calculations for planned AWS installations. Two different antennas are to be used at three different heights, so three different representative NextG antenna scenarios were analyzed: 1) a wooden utility pole with the antenna mounted at least 20 feet above ground on a 3' standoff arm in the Comm Zone; 2) a wooden utility pole with a top-mounted antenna at least 30 feet above ground; and 3) a concrete street light with a top-mounted antenna at least 20 feet above ground. Frequencies could range from 1800 MHz to 2155 MHz.

Our calculations used formulas designated by the FCC and accepted by multiple international standards bodies. "Worst Case Scenarios" were calculated using variables (circumstances) chosen to produce the highest feasible exposure levels. In reality, actual exposure levels would be well below these calculated values. **Based on our analysis, RF Exposure for the General Population will always be below the Maximum Permissible Exposure levels from these installations.**

The FCC RF (Radiofrequency) Exposure Guidelines

FCC **Report and Order 96-326** regarding "Guidelines for Evaluating the Environmental Effects of Radiofrequency Radiation" and FCC **OET Bulletin-65** "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields" establish guidelines and methods for evaluating the environmental effects of radiofrequency (RF) radiation from FCC-regulated transmitters, and sets the Maximum Permissible Exposure (MPE) limits for electric and magnetic field strength and power density for transmitters operating at frequencies from 300 kHz to 100 GHz.[1]

"The FCC's MPE limits are based on exposure limits recommended by the National Council on Radiation Protection and Measurements (NCRP)[2] and, over a wide range of frequencies, the exposure limits developed by the Institute of Electrical and Electronics Engineers, Inc., (IEEE) and adopted by the American National Standards Institute (ANSI) to replace the 1982 ANSI guidelines. Limits for localized absorption are based on recommendations of both ANSI/IEEE and NCRP."[3]

These FCC guidelines delineate methodologies for measuring RF levels, equations for calculating RF levels, limits for maximum permissible human exposure (MPE) and possible solutions for controlling (limiting) RF exposure. All wireless carriers operating in the United States are required to operate in compliance with these standards.

Exposure limits are based on two scenarios: 1) General Population/Uncontrolled Exposure, which is for the general population and which is the more stringent case (lower limits), and 2) Occupational/Controlled Exposure, which is for people working in fields where RF exposure is probable (like cellular technicians or radar engineers) and who are therefore expected to be more knowledgeable about the potential hazards and how to avoid them.

These limits are shown in tables and a chart in Appendix I: the MPE limit for the General Population at the relevant frequencies is a power density of 1 mW/cm^2 (1 milliWatt or 1 thousandths of a Watt per square centimeter). It is important to note that these limits are expressed in terms of ***exposure***, and not ***emissions***, meaning that the concern is with how much RF energy is "hitting" the surface of a human body, not how much is coming from the antennas or "in the air".

Limits for exposure vary depending on the frequency, because the levels of human absorption vary with frequency. The highest levels of absorption happen around 80 MHz (for adults)[4], so the MPE levels are lowest (strictest) around this frequency, specifically the 30-300 MHz range. Limits also factor in a safety

[1] FCC Report and Order 96-326, p.2. See http://www.fcc.gov/Bureaus/Engineering_Technology/Orders/1996/fcc96326.pdf
[2] The NCRP is a non-profit corporation chartered by the U.S. Congress to develop information and recommendations concerning radiation protection.
[3] FCC OET-65 pp. 7-8. See http://www.fcc.gov/oet/info/documents/bulletins/#65.
[4] World Health Organization: See http://www.inchem.org/documents/ehc/ehc/ehc137.htm.

margin of more that a factor of fifty; in other words, the limits are set at a level less than 1/50th the values determined by these organizations from the research to be at all potentially harmful.

Furthermore, these limits are not for instantaneous or transient exposure, but ***exposure over time*** – specifically, exposure averaged over a moving time window of 30 minutes for the General Population. An individual would only exceed the MPE limits if their *average* exposure over any 30-minute time period exceeded the allowable limit. In other words, an individual (General Population) would need to be exposed to 100% of the allowable limit for a full 30 minutes in order to exceed the MPE. Exposure at 150% of the maximum for 15 minutes and then at 50% of the maximum for an additional 15 minutes would also put that individual over the limit because their *average* exposure over that 30 minutes would be 100% of the maximum. A "spike" or transient – even at 1000% of the maximum for a couple seconds every minute – would *not* constitute exceeding the MPE limit because, the *average over the full time period* would not be greater than 100% of the maximum.

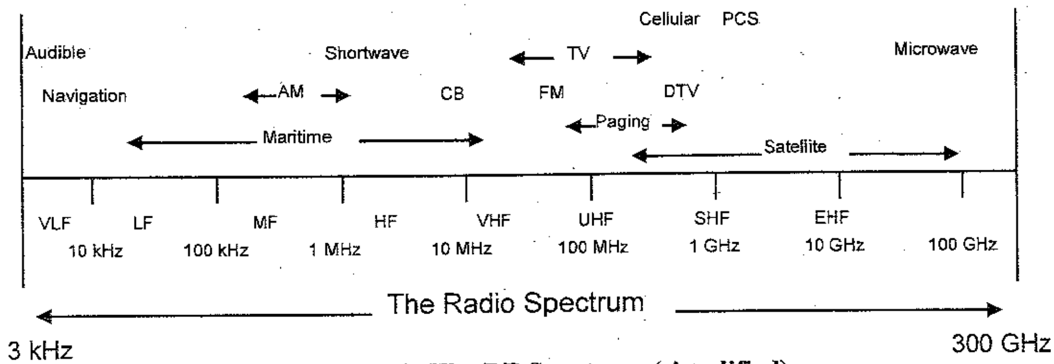


Figure A. The RF Spectrum (simplified)

RF energy in any given area comes from a variety of sources: TV, radio and "cell" towers, hand-held 2-way radios ("walkie-talkies") and cell phones, police cars driving by, even household appliances (e.g. baby monitors, microwave ovens and cordless phones) and cosmic energy. At any given time we are exposed to a certain level of RF exposure from these multiple sources.

But RF energy also dissipates rapidly over distance: Power $\propto$ 1/Distance^2, so if distance increases 10-fold, the power decreases 100-fold. The energy 10 feet away from a given antenna is 1/100th of what it is 1 foot from the antenna; 100 feet from the antenna, it is 1/10,000th of what it is at 1 foot from the antenna. (Think of the surface of a balloon getting thinner and weaker as the balloon is blown up bigger and bigger or light from a flashlight getting weaker and weaker the farther from the source (bulb).)

Furthermore, RF energy is also lessened (attenuated) every time it travels through any kind of substance, such as trees, walls or even our clothing. Thus, especially for members of the general public, our actual levels of exposure are generally very low, and well below the Maximum Permissible Exposure levels.

Radio and TV antennas typically radiate at tens of thousand of Watts. But because these antennas are located on tall towers and well above the populace, the chance of a member of the General Population exceeding the MPE limits from these antennas is low. Microwave relay antennas (typically dishes or drums) operate at higher power levels (thousands of Watts) and are highly directional (concentrate their energy in a narrower "beam"). The chance of exceeding the MPE limits is higher for these antennas, but a person would have to be in the direct path of the energy beam, which is unlikely under normal daily circumstances. For a typical cellular or PCS antenna array, an individual would need to be directly in front of and close to (within a few feet of) for an extended period of time for their exposure to exceed the MPE limits, because these antennas operate at relatively low power levels (a few hundred Watts ERP[5] or

[5] ERP = Effective Radiated Power

less) and have wider beamwidths[6] (radiate their energy over a wide angle). And because these antennas radiate their energy in a particular pattern and direction, anyone to the left, right, behind, above or below an antenna receives a fraction of this energy. In addition, MPE exposure is only relevant if the antenna is *transmitting* and not for receive-only antennas like home satellite dishes (e.g. DirecTV) and most GPS antennas.

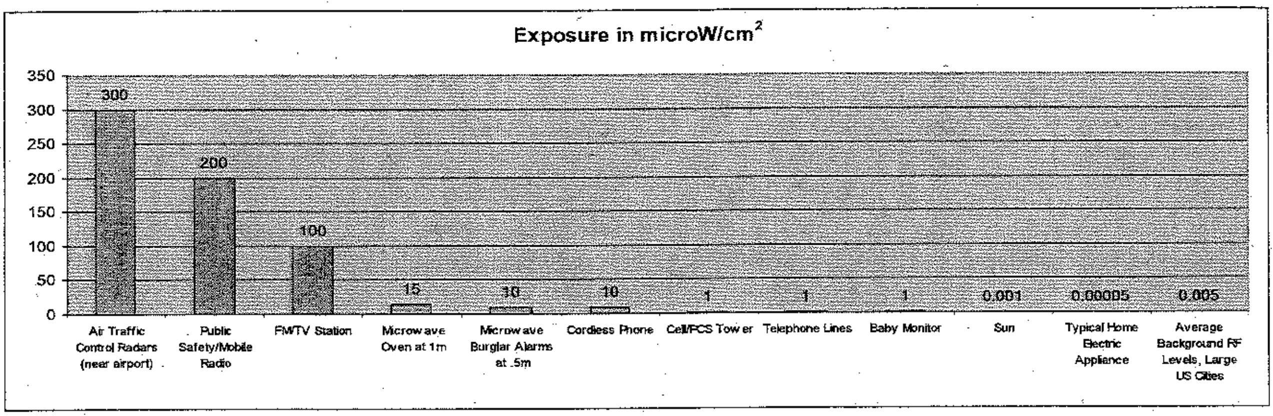


Figure B. Typical RF Exposure Levels

According to the World Health Organization (WHO): "RF exposure from telecommunications facilities is generally less than from radio or TV broadcasting. A study conducted in the United States found that, in large cities, the average background RF levels were about 50 $\mu W/m^2$ (.00005mW/cm^2). About 1% of people living in large cities are exposed to RF fields exceeding 10 mW/m^2 (.001 mW/cm^2)."[7] Recent surveys have shown that the RF exposures from base stations range from 0.002% to 2% of the levels of international exposure guidelines, depending on a variety of factors such as the proximity to the antenna and the surrounding environment. This is lower or comparable to RF exposures from radio or television broadcast transmitters.[8]

Overview/Methodology

NextG Networks requested that RF Maximum Permissible Exposure (MPE) studies be prepared for a variety of typical installations for their planned AWS band networks. MPE RF studies for the planned antenna configurations for these networks have been prepared in accordance with the FCC's guidelines.

Formulas used for our calculations are taken directly from the FCC Guidelines (see Appendix I). RF Exposure for this purpose is calculated as a Power Density, in mW/cm^2. The MPE limit for the General Population at the frequencies for the systems being analyzed is 1 mW/cm^2. An approach of using a "worst case scenario" is used in order to err on the side of caution, so that **actual levels would be much less than those calculated herein.** For example, for the ground-based scenario, to account for a worst-case situation of 100% reflection of incoming radiation from the ground or other nearby surface, a factor (multiplier) of 4 is used in the formulas for these MPE calculations. In reality, any reflection would be less than 100%, so actual values for % MPE would be less than the calculated values. For the antenna height scenarios, it was assumed that a person would be standing directly in front of and facing the antenna for maximum full-body exposure, with nothing (not even clothes) between them and the antennas. So again, actual values would be less than the calculated values.

Ground-based calculations were performed to represent an individual walking near or below an installation. This analysis used far-field calculations, from the antenna out to 400 ft. **Antenna-level** calculations were performed in the horizontal plane at the height of the antenna radiation center. This

[6] Beamwidth is the angle that an antenna radiates into or "covers". Beamwidths can be for the horizontal or vertical planes. Beamwidth is expressed as degrees of a 360° circle with the angle represented by the 50% power points. Typical horizontal beamwidths for cellular and PCS antennas are between 50° and 90°. Vertical beamwidths are much narrower, typically between 5° and 20°.

[7] WHO Fact Sheet #183, Reviewed May 1998. See http://www.who.int/docstore/peh-emf/publications/facts_press/efact/efs183.html.

[8] WHO Fact Sheet #394, May 2005. See http://www.who.int/mediacentre/factsheets/fs304/en/index.html.

analysis used near-field calculations to represent worst-case radiation for utility personnel on or near the antenna structure or people above ground level in nearby buildings. The whole-body 100% MPE distance has been calculated, so that *at any distance from the antenna greater than this, exposure will always be less than 100% of the MPE, i.e. within allowable limits.*

For the ground-based calculations, the calculations incorporated the vertical antenna pattern shown in the Antenna Specifications for the Phazar Antenna Corp AWS360-1710-7-T0-N and AWS360-1710-10-T0-N (Attachments 1 and 2).

Typical foliage and building signal attenuations were also not factored in, so again, calculated values would be higher than actual values.

Configurations/Study Parameters

The proposed network will use Comm Zone and Pole-top installations on wooden utility poles and Light-top installations on concrete street lights. The Comm Zone is a zone on a utility pole reserved for mounting communications equipment. The Comm Zone configuration consists of the AWS360-1710-7-T0-N antenna on a 3 ft. stand-off and at an antenna radiation height of 21 ft. The Pole-top configuration consists of a top-mounted AWS360-1710-10-T0-N antenna at an antenna radiation height of 32 ft. The Light-top configuration consists of a top-mounted AWS360-1710-10-T0-N antenna at an antenna radiation height of 22 ft. These calculations would also be valid for configurations with antennas at any height greater than that stated for each scenario.

Operating Parameters used for MPE calculations with AWS360-1710-7-T0-N antenna (Scenario 1)

Frequency:	1800 MHz and above (The FCC Limits for MPE are the same from 1,500 – 100,000 MHz)
Antenna:	Phazar Antenna Corp AWS360-1710-7-T0-N Omni Antenna, with 7 dBi gain
	(Antenna in Comm Zone configuration will be mounted using a 3' standoff on a wooden pole)
Transmitter:	40 watts (46 dBm), 2 channels in simultaneous use
Cable Loss:	-1.2 dB
Power into Antenna:	44.8 dBm (30.2 watts)
Antenna C/L:	21' (min. radiation center height) Scenario 1
EIRP:	46dBm – 1.2dB + 7dB = 51.8dBm (ERP = EIRP - 2.15dB = 49.65dBm, or 92.3 Watts)

Operating Parameters used for MPE calculations with AWS360-1710-10-T0-N antenna (Scenarios 2 & 3)

Frequency:	1800 MHz and above (The FCC Limits for MPE are the same from 1,500 – 100,000 MHz)
Antenna:	Phazar Antenna Corp AWS360-1710-10-T0-N Omni Antenna, with 10 dBi gain
Transmitter:	40 watts (43 dBm), 2 channels in simultaneous use
Cable Loss:	-1.2 dB
Power into Antenna:	44.8 dBm (30.2 watts)
Antenna C/L:	Scenario 2: 32' (minimum radiation center at the top of wooden utility poles)
	Scenario 3: 22' (minimum radiation center at the top of concrete street light)
EIRP:	46dBm – 1.2dB + 10dB = 54.8dBm (ERP = EIRP - 2.15dB = 52.65dBm, or 184.6 Watts)

Analysis and Conclusions

Scenario 1 (Comm Zone):
Ground-based calculations show that the worst-case exposure level on the ground is .0172 mW/cm² which is 1.72% of the FCC's MPE limit for General Population/Uncontrolled Exposure, and occurs 55 feet away from the base of the antenna. **Therefore, a person on the ground would always be below the MPE limit.**

Antenna height calculations show that at a distance of 9.84 inches from the antenna and with one's full body directly in front of the antenna, the worst-case whole body power density is 100% of the FCC's MPE limit for General Population/Uncontrolled Exposure. This means that *at distances greater than 10 inches, exposure will always be less than 100% of the limit.* Power density and corresponding percentage of the FCC MPE limit fall off rapidly with distance, so at 12 inches from the antenna, the worst-case maximum power density is 84% of the FCC's MPE limit. At 2 feet from the antenna, the maximum power density is 43% of the FCC's MPE limit. **Therefore, a climber on the pole, a maintenance person in a bucket, or anyone in a nearby structure would be below the MPE limit under any normal circumstances.**

Scenario 2 (Pole Top at 32'):
Ground-based calculations show that the worst case exposure on the ground is .0048 mW/cm² which is 0.48% (1/2 of 1%) of the FCC's MPE limit for General Population/Uncontrolled Exposure, and occurs 45 feet away from the base of the antenna. **Therefore, a person on the ground would always be below the MPE limit.**

Antenna height calculations show that at a distance of 9.84 inches from the antenna and with one's full body directly in front of the antenna, the worst-case whole body power density is 100% of the FCC's MPE limit for General Population/Uncontrolled Exposure. This means that *at distances greater than 10 inches, exposure will always be less than 100% of the limit*. Power density and corresponding percentage of the FCC MPE limit fall off rapidly if one is below – or even partly below – the antenna. Given that the antenna is mounted on the top of the pole and with a 6 inch mounting bracket, a climber on the pole would never be able to have his or her full body directly in front of the antenna, but would always be at least partially below the antenna. **Therefore, a climber on the pole, a maintenance person in a bucket, or anyone in a nearby structure would be below the MPE limit under any normal circumstances.**

Scenario 3 (Pole Top at 22'):
Ground-based calculations show that the worst case exposure (power density) on the ground is .0108 mW/cm² which is 1.08% of the FCC's MPE limit for General Population/Uncontrolled Exposure, and occurs 30 feet away from the base of the antenna. **Therefore, a person on the ground would always be below the MPE limit.**

The antenna height calculations for Scenario 3 are the same as for Scenario 2 because they are using the same antenna in this configuration. **Therefore, a climber on the pole, a maintenance person in a bucket, or anyone in a nearby structure would be below the MPE limit under any normal circumstances.**

Based on our analysis, RF Exposure for the General Population would always be below the Maximum Permissible Exposure levels from these installations. An information sign indicating the status of and contact information for each installation should be placed near the antenna. A typical sign for such purpose is shown in Attachment 3.

Caveats
These calculations are based on the assumption that the specified equipment is operating properly and in accordance with its relevant specifications. Values could be different – and higher – for faulty, broken or misconnected equipment.

It must also be noted that these calculations are only for exposure from the equipment as specified in this report, i.e. the NextG proposed configurations, and do not factor in exposure from other sources. However, because these calculations are based on "worst case" scenarios, because the limits on the ground are such a small fraction of the MPE, and because ambient exposure is also typically very low level, actual exposure should remain well below the 100% MPE levels.

This report has been developed by me and/or under my supervision. All facts and statements contained herein are true and accurate to the best of my knowledge, except where stated to be in information or belief.

Julia Ann V Schmitt 8/11/08
Signature Date

Julia Ann V. Schmitt, PE (NJ)
License #24GE04352800 (New Jersey)

APPENDIX I - Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields

On August 25, 1997, the FCC adopted OET-65, regarding Compliance to Safety Limits for Human Exposure to RF Emissions. These guidelines are designed to help protect both the general population and those who spend extended periods of time working in these environments.

The full document can be downloaded at http://www.fcc.gov/oet/info/documents/bulletins/#65.

The formulae used for this report (and their derivation) can be found in OET Bulletin 65 Edition 97-01, p. 18*ff*.

The main formula used for Ground-Based (Far Field) Calculations is #5 on p. 20:

$$S = \frac{EIRP}{4\Pi R^2} = \frac{1.64\ ERP}{4\Pi R^2} = \frac{0.41\ ERP}{\Pi R^2}$$

Where

S = power density (in appropriate units, e.g. mW/cm2)
EIRP = equivalent (or effective) isotropically radiated power (in appropriate units, e.g., mW)
ERP = power referenced to a half-wave dipole radiator instead of to an isotropic radiator
R = distance to the center of radiation of the antenna (appropriate units, e.g., cm)

For a truly worst-case prediction of power density at or near a surface, such as at ground level or on a rooftop, 100% reflection of incoming radiation can be assumed, resulting in a potential doubling of predicted field strength and a four-fold increase in (far-field equivalent) power density. In that case the above Equation is modified to:

$$S = \frac{EIRP}{\Pi R^2} = \frac{1.64\ ERP}{\Pi R^2} = \frac{1.64\ ERP}{\Pi R^2}$$

The main formula used for Antenna Height (Near Field) Calculations is #20 on p. 32:

$$S = \frac{180\ P_{net}}{\Theta_{BW} \Pi R h}$$

Where

S = power density (in appropriate units, e.g. mW/cm2)
P_{net} = net power input to the antenna (in appropriate units, e.g., mW)
Θ_{BW} = beam width of the antenna in degrees
R = distance from the antenna (appropriate units, e.g., cm)
h = aperture height of the antenna

This provides the aperture power density. Whole body power density is then calculated based on the worst-case geometry of the scenario and the percent of whole-body exposure.

As per FCC guidelines, a 6' human is used as the standard for calculations.

The following tables and graphs, taken directly from OET Bulletin 65 Edition 97-01, p. 67*ff*, show the Summary of RF Exposure Guidelines.

FCC Limits for Maximum Permissible Exposure (MPE)

(A) Limits for Occupational Population/Controlled Exposure

Frequency Range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (H) (A/m)	Power Density (S) (mW/cm^2)	Averaging Time $\|E\|^2$, $\|H\|^2$ or S (minutes)
0.3-3.0	614	1.63	(100)*	6
3.0-30	1842/f	4.89/f	$(900/f^2)$*	6
30-300	61.4	0.163	1.0	6
300-1500	--	--	f/300	6
1500-100,000	--	--	5	6

(B) Limits for General Population/Uncontrolled Exposure

Frequency Range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (H) (A/m)	Power Density (S) (mW/cm^2)	Averaging Time $\|E\|^2$, $\|H\|^2$ or S (minutes)
0.3-1.34	614	1.63	(100)*	30
1.34-30	824/f	2.19/f	$(180/f^2)$*	30
30-300	27.5	0.073	0.2	30
300-1500	--	--	f/1500	30
1500-100,000	--	--	1.0	30

f = frequency in MHz *Plane-wave equivalent power density

NOTE 1: See Appendix 2 for definition of exposure categories (Occupational/Controlled, General/Uncontrolled).
NOTE 2: The averaging time for General Population/Uncontrolled exposure to fixed transmitters is not applicable for mobile and portable transmitters. See 47 CFR §§2.1091 and 2.1093 on source-based time-averaging requirements for mobile and portable transmitters.

FCC Limits for Specific Absorption Rate (SAR)

(A) Limits for Occupational/Controlled Exposure (W/kg)

Whole-Body	Partial-Body	Hands, Wrists, Feet and Ankles
0.4	8.0	20.0

(B) Limits for General Population/Uncontrolled Exposure (W/kg)

Whole-Body	Partial-Body	Hands, Wrists, Feet and Ankles
0.08	1.6	4.0

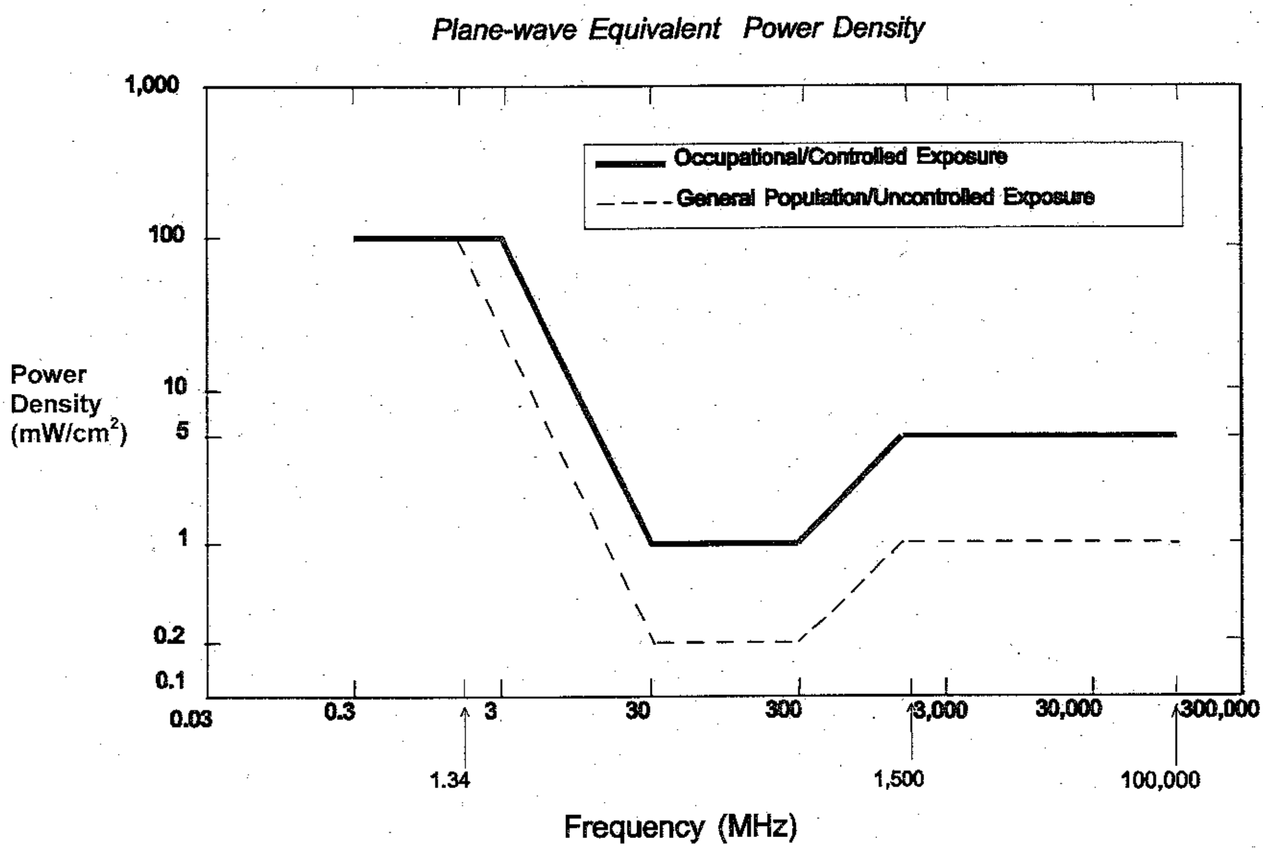
NOTE 1: See Appendix 2 for definition of exposure categories (Occupational/Controlled, General/Uncontrolled).

NOTE 2: *Whole-Body SAR* is averaged over the entire body, *partial-body SAR* is averaged over any 1 gram of tissue defined as a tissue volume in the shape of a cube. *SAR for hands, wrists, feet and ankles* is averaged over any 10 grams of tissue defined as a tissue volume in the shape of a cube.

NOTE 3: At frequencies above 6.0 GHz, SAR limits are not applicable and MPE limits for power density should be applied at 5 cm or more from the transmitting device.

NOTE 4: The time averaging criteria for field strength and power density do not apply to general population SAR limit of 47 CFR §2.1093.

Figure 1. FCC Limits for Maximum Permissible Exposure (MPE)



Another excellent resource for a "plain English" explanation of RF Exposure is the FCC document "A Local Government Official's Guide to Transmitting Antenna RF Emission Safety: Rules, Procedures, and Practical Guidance" developed by the Federal Communications Commission (FCC) and its Local and State Government Advisory Committee (LSGAC).

This document is available on the Internet at http://wireless.fcc.gov/siting/FCC_LSGAC_RF_Guide.pdf.

APPENDIX II - DEFINITIONS AND GLOSSARY OF TERMS

The following has been taken directly from OET Bulletin 65 Edition 97-01, p. 2*ff*.

The following specific words and terms are used in this bulletin. These definitions are adapted from those included in the American National Standards Institute (ANSI) 1992 RF exposure standard [Reference 1], from NCRP Report No. 67 [Reference 19] and from the FCC's Rules (47 CFR § 2.1 and § 1.1310).

Average (temporal) power. The time-averaged rate of energy transfer.

Averaging time. The appropriate time period over which exposure is averaged for purposes of determining compliance with RF exposure limits (discussed in more detail in Section 1).

Continuous exposure. Exposure for durations exceeding the corresponding averaging time.

Decibel (dB). Ten times the logarithm to the base ten of the ratio of two power levels.

Duty factor. The ratio of pulse duration to the pulse period of a periodic pulse train. Also, may be a measure of the temporal transmission characteristic of an intermittently transmitting RF source such as a paging antenna by dividing average transmission duration by the average period for transmissions. A duty factor of 1.0 corresponds to continuous operation.

Effective radiated power (ERP) (in a given direction). The product of the power supplied to the antenna and its gain relative to a half-wave dipole in a given direction.

Equivalent Isotropically Radiated Power (EIRP). The product of the power supplied to the antenna and the antenna gain in a given direction relative to an isotropic antenna.

Electric field strength (E). A field vector quantity that represents the force (F) on an infinitesimal unit positive test charge (q) at a point divided by that charge. Electric field strength is expressed in units of volts per meter (V/m).

Energy density (electromagnetic field). The electromagnetic energy contained in an infinitesimal volume divided by that volume.

Exposure. Exposure occurs whenever and wherever a person is subjected to electric, magnetic or electromagnetic fields other than those originating from physiological processes in the body and other natural phenomena.

Exposure, partial-body. Partial-body exposure results when RF fields are substantially nonuniform over the body. Fields that are nonuniform over volumes comparable to the human body may occur due to highly directional sources, standing-waves, re-radiating sources or in the near field. See **RF "hot spot".**

Far-field region. That region of the field of an antenna where the angular field distribution is essentially independent of the distance from the antenna. In this region (also called the free space region), the field has a predominantly plane-wave character, i.e., locally uniform distribution of electric field strength and magnetic field strength in planes transverse to the direction of propagation.

Gain (of an antenna). The ratio, usually expressed in decibels, of the power required at the input of a loss-free reference antenna to the power supplied to the input of the given antenna to produce, in a given direction, the same field strength or the same power density at the same distance. When not specified otherwise, the gain refers to the direction of maximum radiation. Gain may be considered for a specified polarization. Gain may be referenced to an isotropic antenna (dBi) or a half-wave dipole (dBd).

General population/uncontrolled exposure. For FCC purposes, applies to human exposure to RF fields when the general public may be exposed or in which persons who are exposed as a consequence of their employment may not be made fully aware of the potential for exposure or cannot exercise control over their exposure. Therefore, members of the general public always fall under this category when exposure is not employment-related.

Hertz (Hz). The unit for expressing frequency, (*f*). One hertz equals one cycle per second.

Magnetic field strength (H). A field vector that is equal to the magnetic flux density divided by the permeability of the medium. Magnetic field strength is expressed in units of amperes per meter (A/m).

Maximum permissible exposure (MPE). The rms and peak electric and magnetic field strength, their squares, or the plane-wave equivalent power densities associated with these fields to which a person may be exposed without harmful effect and with an acceptable safety factor.

Near-field region. A region generally in proximity to an antenna or other radiating structure, in which the electric and magnetic fields do not have a substantially plane-wave character, but vary considerably from point to point. The near-field region is further subdivided into the reactive near-field region, which is closest to the radiating structure and that contains most or nearly all of the stored energy, and the radiating near-field region where the radiation field predominates over the reactive field, but lacks substantial plane-wave character and is complicated in structure. For most antennas, the outer boundary of the reactive near field region is commonly taken to exist at a distance of one-half wavelength from the antenna surface.

Occupational/controlled exposure. For FCC purposes, applies to human exposure to RF fields when persons are exposed as a consequence of their employment and in which those persons who are exposed have been made fully aware of the potential for exposure and can exercise control over their exposure. Occupational/controlled exposure limits also apply where exposure is of a transient nature as a result of incidental passage through a location where exposure levels may be above general population/uncontrolled limits (see definition above), as long as the exposed person has been made fully aware of the potential for exposure and can exercise control over his or her exposure by leaving the area or by some other appropriate means. The occupational/controlled exposure limits also apply to amateur radio operators and members of their immediate household.

Peak Envelope Power (PEP). The average power supplied to the antenna transmission line by a radio transmitter during one radiofrequency cycle at the crest of the modulation envelope taken under normal operating conditions.

Power density, average (temporal). The instantaneous power density integrated over a source repetition period.

Power density (S). Power per unit area normal to the direction of propagation, usually expressed in units of watts per square meter (W/m^2) or, for convenience, units such as milliwatts per square centimeter (mW/cm^2) or microwatts per square centimeter ($\mu W/cm^2$). For plane waves, power density, electric field strength (E) and magnetic field strength (H) are related by the impedance of free space, i.e., 377 ohms, as discussed in Section 1 of this bulletin. Although many survey instruments indicate power density units ("far-field equivalent" power density), the actual quantities measured are E or E^2 or H or H^2.

Power density, peak. The maximum instantaneous power density occurring when power is transmitted.

Power density, plane-wave equivalent or far-field equivalent. A commonly-used terms associated with any electromagnetic wave, equal in magnitude to the power density of a plane wave having the same electric (E) or magnetic (H) field strength.

Radiofrequency (RF) spectrum. Although the RF spectrum is formally defined in terms of frequency as extending from 0 to 3000 GHz, for purposes of the FCC's exposure guidelines, the frequency range of interest in 300 kHz to 100 GHz.

Re-radiated field. An electromagnetic field resulting from currents induced in a secondary, predominantly conducting, object by electromagnetic waves incident on that object from one or more primary radiating structures or antennas. Re-radiated fields are sometimes called "reflected" or more correctly "scattered fields." The scattering object is sometimes called a "re-radiator" or "secondary radiator".

RF "hot spot." A highly localized area of relatively more intense radio-frequency radiation that manifests itself in two principal ways:

(1) The presence of intense electric or magnetic fields immediately adjacent to conductive objects that are immersed in lower intensity ambient fields (often referred to as re-radiation), and

(2) Localized areas, not necessarily immediately close to conductive objects, in which there exists a concentration of RF fields caused by reflections and/or narrow beams produced by high-gain radiating antennas or other highly directional sources. In both cases, the fields are characterized by very rapid changes in field strength with distance. RF hot spots are normally associated with very nonuniform

exposure of the body (partial body exposure). This is not to be confused with an actual thermal hot spot within the absorbing body.

Root-mean-square (rms). The effective value, or the value associated with joule heating, of a periodic electromagnetic wave. The rms value is obtained by taking the square root of the mean of the squared value of a function.

Scattered radiation. An electromagnetic field resulting from currents induced in a secondary, conducting or dielectric object by electromagnetic waves incident on that object from one or more primary sources.

Short-term exposure. Exposure for durations less than the corresponding averaging time.

Specific absorption rate (SAR). A measure of the rate of energy absorbed by (dissipated in) an incremental mass contained in a volume element of dielectric materials such as biological tissues. SAR is usually expressed in terms of watts per kilogram (W/kg) or milliwatts per gram (mW/g). Guidelines for human exposure to RF fields are based on SAR thresholds where adverse biological effects may occur. When the human body is exposed to an RF field, the SAR experienced is proportional to the squared value of the electric field strength induced in the body.

Wavelength (λ). The wavelength (λ) of an electromagnetic wave is related to the frequency (f) and velocity (v) by the expression $v = f\lambda$. In free space the velocity of an electromagnetic wave is equal to the speed of light, i.e., approximately 3×10^8 m/s.

APPENDIX III – CMX AND COMP COMM STATEMENT OF EXPERIENCE

COMP COMM, Inc. is an independent wireless communications engineering consulting firm. Since 1975, COMP COMM has made a business of solving complex technical and operational problems in wireless communications. While serving a broad base of both public and private clients, the company has maintained its focus on the expansion of wireless services throughout the United States. COMP COMM has provided its services through CMX Engineering or its subsidiaries since 1998

Company History
In our early years, COMP COMM provided comprehensive engineering services and technical support to FCC frequency spectrum applicants. The company soon gained recognition as a reliable industry resource and was employed to design wireless systems during the early years of cellular. COMP COMM designed 18 of the 30 largest markets and successfully defended all its designs during the FCC comparative hearing process. Our engineers designed and evaluated hundreds of systems ranging from the original New York City cellular system to single-site rural radio applications.

After years of in-house design work, COMP COMM's extensive experience and capabilities were tapped to design, build and operate multiple cellular systems. The Company managed these systems from successful application and license award; through system design, build-out and operation; to marketing and subsequent sale. COMP COMM has provided significant field work for its clients, including evaluation of sites throughout the country to ensure compliance with FCC and FAA regulations. Through these services, we assure systems operate within authorized parameters and at peak efficiency.

In 1996, the company began leveraging its years of expertise to help local governments develop unbiased, fact-based and cost-effective solutions to their wireless issues – solutions which consider the interests of all their constituents.

Outside Recognition
COMP COMM and its principals are recognized experts on issues of wireless communications facilities by the industry and from a local government perspective. Dr. George Schrenk, COMP COMM's founder and Chairman Emeritus, is a Senior Member of the Institute of Electrical and Electronics Engineers (IEEE), and has authored works for the IEEE Vehicular Technology Society Committee on Radio Propagation. Christine Malone, COMP COMM's President, has been qualified as an Expert Witness in testimony before multiple Boards, Councils, Committees, etc. She has been an invited speaker at national conferences and seminars, including the 2007 Law Seminars International Local Broadband Deployment and Regulation conference in Tampa, the 1999 NATOA Annual Conference in Atlanta, and 2001 Forum on Cable/Telco Franchising. Ms. Malone is also the author of the "plain English" primer "How Wireless Works" published by the Massachusetts Wireless Collaborative of the *Massachusetts Municipal Association* as part of their publication, Working with Wireless, (recently re-printed by popular demand) and articles such as "What's on Your Roof?" published in the March 2003 issue of Buildings magazine.

COMP COMM has also been featured or quoted in many articles and radio and television programs on wireless facilities issues for local governments, including a feature article in the September 1999 issue of American City and County magazine.

Julia Ann Schmitt, has been an engineer with Comp Comm since 1994. She has a B.S. in Electrical Engineering from Georgia Institute of Technology and a B.S. in Mathematics from Oglethorpe University. She is also a Professional Engineer (P.E.) licensed in the State of New Jersey (NJ License #24GE04352800).

Related Experience
COMP COMM has provided RF exposure analyses for multiple clients - industry, commercial and government - including the City of Rye, NY, The Town of Port Chester, NY, Horton Commercial Realty (MI), Florida Power & Light, and Independent Wireless One Corp. (part of Sprint/Nextel), and has conducted seminars on the subject for such clients as the Town of Carlsbad, CA and Southampton, NY.

ATTACHMENT 1: Antenna Specifications - Phazar Antenna Corp. AWS360-1710-7-T0-N

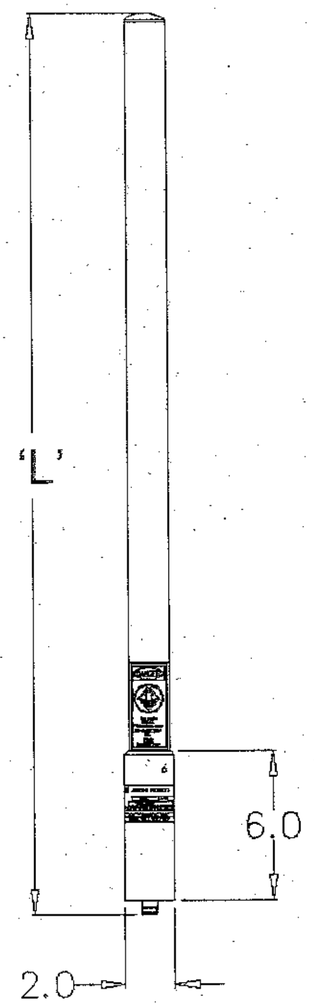
Phazar Antenna Corp.

1710 – 2155 MHz Omni-Directional Antenna

- Rugged, fiberglass radome
- Frequency coverage for entire AWS band

Model AWS360-1710-7-T0-N

Preliminary Data

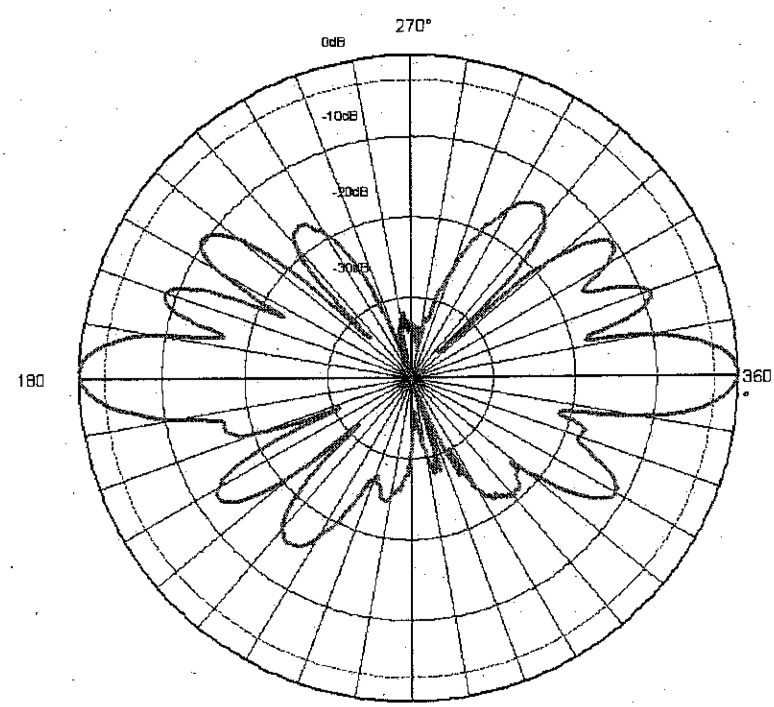


ELECTRICAL SPECIFICATIONS

Frequency Range	1710-2155 MHz
VSWR	1.7:1 VSWR Max
Forward Gain	7 dBi
Polarization	Vertical
Maximum Power Input	200 Watts
Input Impedance	50 ohms
Vertical -3dB Beamwidth	16° +/- 1° (nominal)
Horizontal -3dB Beamwidth	360° +/- 5°
Azimuth Ripple	+/- .5 dB
Electrical Downtilt	2 and 4° (T2 and T4 for Part Number)

MECHANICAL & ENVIRONMENTAL SPECIFICATIONS

Connector	Type 'N' Male or 716 DIN
Mounting	Side mount; clamps provided
Dimension and Weight	26 inches x 2.0 inch O.D. / < 10 lbs.
Color	White Standard (Color Options Available)
Wind Survival	120 mph.
Lightning Protection	Direct Ground



Pattern is for 9 dBi model.

Phazar Antenna Corp. 101 SE 25TH Ave. Mineral Wells, TX 76067 940-325-3301 fax 940-325-0716 www.phazar.com

ATTACHMENT 2: Antenna Specifications - Phazar Antenna Corp. AWS360-1710-10-T0-N

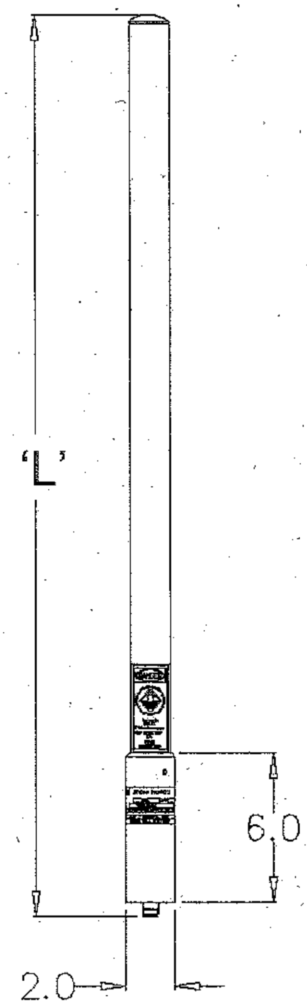
Phazar Antenna Corp.

1710 – 2155 MHz Omni-Directional Antenna

- Rugged, fiberglass radome
- Frequency coverage for entire AWS band

Model AWS360-1710-10-T0-N

Preliminary Data

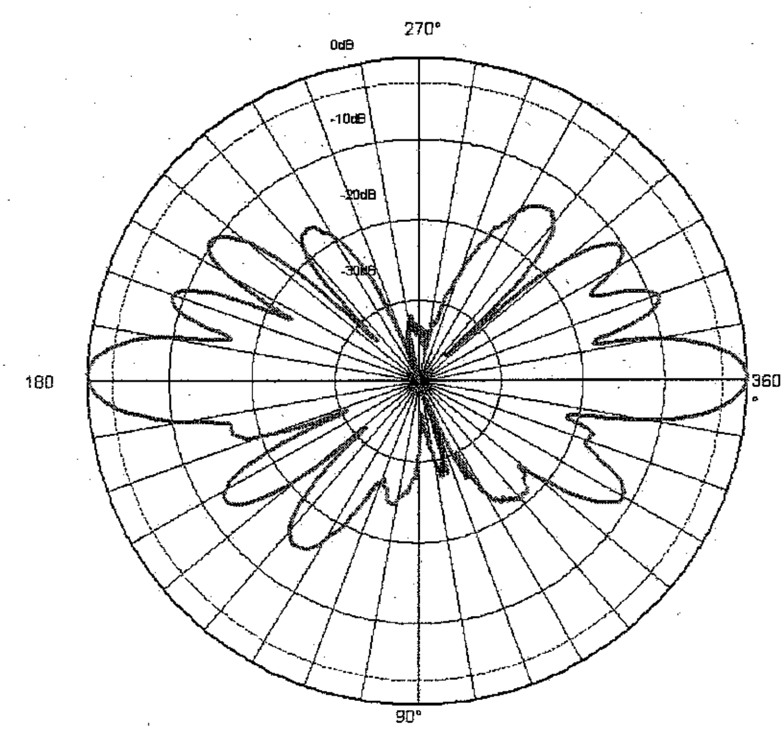


ELECTRICAL SPECIFICATIONS

Frequency Range	1710-2155 MHz
VSWR	1.7:1 VSWR Max
Forward Gain	10 dBi
Polarization	Vertical
Maximum Power Input	200 Watts
Input Impedance	50 ohms
Vertical -3dB Beamwidth	7° +/- 1° (nominal)
Horizontal -3dB Beamwidth	360° +/- 5°
Azimuth Ripple	+/- .5 dB
Electrical Downtilt	2 and 4° (T2 and T4 for Part Number)

MECHANICAL & ENVIRONMENTAL SPECIFICATIONS

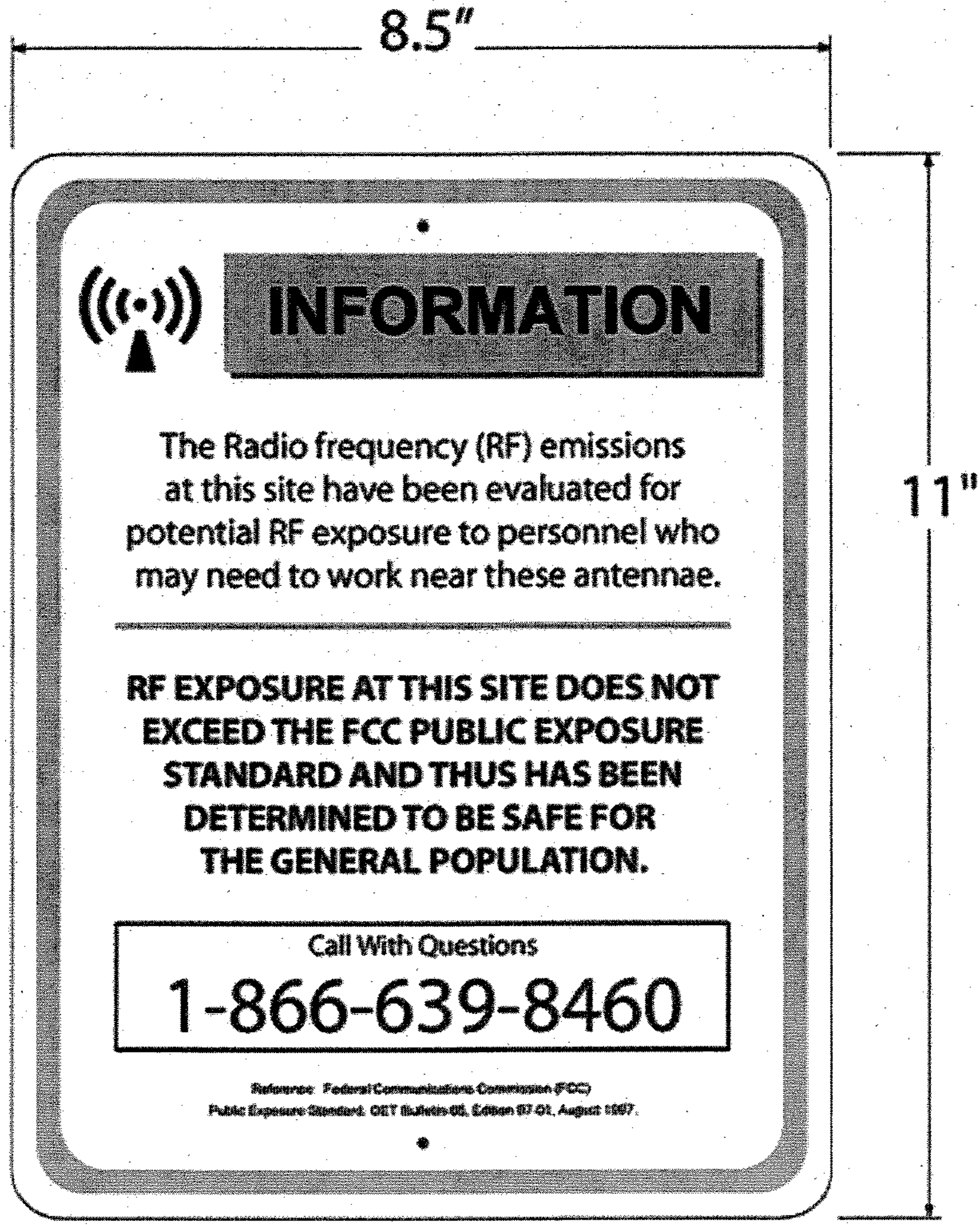
Connector	Type 'N' Male or 716 DIN
Mounting	Side mount; clamps provided
Dimensions and Weight	48 inches x 2.0 inches O.D. / < 10
Color	White Standard (Color Options Available)
Wind Survival	120 mph.
Lightning Protection	Direct Ground



Pattern is for 9 dBi model.

Phazar Antenna Corp. 101 SE 25TH Ave. Mineral Wells, TX 76067 940-325-3301 fax 940-325-0716 www.phazar.com

ATTACHMENT 3: Typical RF Information Signage



ATTACHMENT 4: Typical NextG Networks Installation

These photos are taken from (and other examples are available a) the NextG Networks web site at http://www.nextgnetworks.net/solutions/photosdiagrams.html.

Omnidirectional antenna on a street-light pole-top

Directional (panel) antennas on a utility pole stand-off

Information Package

NextG Networks

CITY OF BOSTON

Overview of NextG Networks, Inc
Distributed Antenna System Project

Respectfully Submitted to

Mr. Vincent Leo

NEXTG PROPRIETARY AND CONFIDENTIAL - FOR CITY INTERNAL USE ONLY AND NOT FOR RELEASE UNDER PUBLIC RECORDS REQUESTS

April 20, 2009

Project Description

NextG Networks of NY, Inc. *dba* NextG Networks East ("NextG") executed a license agreement with the City of Boston on August 28th, 2003 to locate, place, attach, install, operate, and maintain its equipment on existing utility poles or streetlights in or on the public way for the purposes of operating its telecommunications network known as a Distributed Antenna System (DAS). Currently, NextG is in the process of finalizing its network construction after over a year of lengthy approval process before the Boston Public Improvement Commission. NextG filed multiple (approximately 15 total), extensive, and detailed separate petitions with the PIC, each petition requiring at least two public hearings duly advertised in both of the newspapers of general circulation.

As a wireline telephone company, NextG is classified as a common exchange carrier under Massachusetts's law and is regulated by the Massachusetts Department of Telecommunications and Cable. NextG is the leading provider of outdoor DAS networks to wireless carriers throughout the United States. The DAS networks NextG provides enhance the performance of its wireless client's infrastructure through the use of strategically placed low-power, small, and unobtrusive equipment locations known as "nodes". Based on innovative fiber optic and radio frequency architectures, NextG's networks support numerous wireless standards, frequencies, services, and technologies, as well as the ability to accommodate multiple wireless carriers simultaneously without the need for additional equipment.

Project Specifics

There are a total of approximately 172 "node" locations submitted before PIC and currently constructed or planned for immediate construction for the entire City of Boston along with approximately 70 miles of fiber (aerial, and underground in conduit). The majority of the "nodes" are installed on either existing third party owned wooden utility poles, or City owned streetlights. The utility poles are owned either by Nstar Electric, Verizon, or are jointly owned. NextG has agreements in place with both entities that will allow for our node equipment attachments.

Project Benefits to the City and its Constituents

- The City of Boston constitutes roughly one-half of NextG's entire design in the Boston metro area and the network installed will enable robust and affordable coverage for all of Boston's citizens.
- NextG's DAS network is visually unobtrusive offering low visual impact to the community while offering performance improvements for NextG's wireless carrier customers to include increased voice quality, greater handling of call traffic, fewer dropped calls, better mobile coverage, facilitate E911 services through ubiquitous coverage, faster file transfers, and enhanced video quality. The DAS network will also support advancements in technology as the WSP's apply them to their networks.

- Each node can support and improve coverage for several wireless operators on a single pole.
- Under the terms of the 2003 license agreement with the City, NextG has been paying the City an annual fee of $15,000 since 2003, which will increase, to 5% of NextG gross revenues once the DAS network is operational, which was February of 2009. As additional carriers are added to the network, this revenue share for the City increases.
- NextG has and will provide fiber strands and/or spare conduit for the City's use along NextG's entire DAS network design. Provisions for this excess capacity comply with the City's policies for shadow duct and aerial fiber installations. This excess capacity could be utilized by the City to support and facilitate the "Open Air Boston" initiative by providing connectivity to City wi-fi or other City owned fiber-fed equipment necessary for public health safety and welfare.
- Where feasible and practical, NextG offered and implemented a unique excavation method called "micro trenching" that substantially minimized impact and intrusion into the public way in areas of the City where digging could not be avoided. The specially designed fiber pathway in many instances was installed in the roadway near the curb line in a pre-cut trench measuring approximately only ½ inch wide and 9 inches (or less) deep.
- Nearly 1 million in permit dollars paid to the City to date.
- Hired local crews over the course of 18 months and assisted a new carrier to successfully enter the market in Boston who has opened stores throughout the greater Boston Metro area, supplying jobs, competition, and a general overall benefit to the economy.

Information is also available on the Company's website: www.nextgnetworks.net

Public Improvement Commission Actions for NextG Networks Boston Buildout

NEXTG PROPRIETARY AND CONFIDENTIAL - FOR CITY INTERNAL USE ONLY AND NOT FOR RELEASE UNDER PUBLIC RECORI

Street	Limits	District Name	Action	Petition Dated	Prelim Hearing	Final Hearing (VOTE)	Date Installed
Lexington St	at a pole 20 ft NE of Marion St	East Boston	Swap-Out, COB Light	12/28/2007	1/3/08	3/20/08	5/21/2008
Bennington St	at the E'ly corner of Putnam St	East Boston	Swap-Out, COB Light	12/28/2007	1/3/08	3/20/08	5/21/2008
George R Visconti Rd	at the N'ly corner of Havre St	East Boston	Swap-Out, COB Light	12/28/2007	1/3/08	3/20/08	5/21/2008
Porter St	at a pole 60 ft SE of Bremen St	East Boston	Swap-Out, COB Light	12/28/2007	1/3/08	3/20/08	5/22/2008
Everett St	at a pole at the corner of Cottage St Pole	East Boston	3rd party node (wood pole)	12/28/2007	1/3/08	1/24/08	12/23/2008
Princeton St	a pole 200 ft SW of Shelby St Pole # 18-:	East Boston	3rd party node (wood pole)	12/28/2007	1/3/08	1/24/08	7/21/2008
Brooks St	opposite West Eagle St Pole # 23-11-1	East Boston	3rd party node (wood pole)	12/28/2007	1/3/08	1/24/08	5/12/2008
Sumner St	at Lamson	East Boston	Stand Alone Pole		N/A	N/A	1/27/2009
Meridian St	at Maverick Square	East Boston	New COB Light & Flag Pole		N/A	N/A	1/12/2009
L St	at the SW'ly corner of East 2nd St	South Boston	Swap-Out, COB Light	2/8/2008	4/17/08	4/22/08	8/15/2008
Farragut Rd	on the E'ly side 160 ft N of East 2nd St	South Boston	Swap-Out, COB Light	2/8/2008	4/17/08	4/22/08	8/5/2008
East 5th St	at the NW corner of P St	South Boston	Swap-Out, COB Light	2/8/2008	4/17/08	4/22/08	8/6/2008
East Broadway	at the N'ly side 25 ft W of N St	South Boston	Swap-Out, COB Light	2/8/2008	4/17/08	4/22/08	8/22/2008
East 7th St	on the S'ly side 20 ft E of M St	South Boston	Swap-Out, COB Light	2/8/2008	4/17/08	4/22/08	8/5/2008
K St	at the SW'ly corner of East 5th St	South Boston	Swap-Out, COB Light	2/8/2008	4/17/08	4/22/08	9/8/2008
East 8th St	at the SW corner of I St	South Boston	Swap-Out, COB Light	2/8/2008	4/17/08	4/22/08	8/5/2008
East 6th St	at the SW corner of H St	South Boston	Swap-Out, COB Light	2/8/2008	4/17/08	4/22/08	8/22/2008
East 4th St	60 ft E of the E'ly line of G St	South Boston	Swap-Out, COB Light	2/8/2008	4/17/08	4/22/08	8/5/2008
East Broadway	at the SE corner of I St	South Boston	Swap-Out, COB Light	2/8/2008	4/17/08	4/22/08	8/4/2008
Old Harbor St	at Thomas Park opposite Telegraph St	South Boston	3rd party node (wood pole)	2/8/2008	4/17/08	4/22/08	9/15/2008
Austin St	at Rutherford Ave	Charlestown	Swap-Out, COB Light	2/22/2008	4/17/08	5/22/08	8/4/2008
Main St	at Bunker Hill St	Charlestown	Swap-Out, COB Light	2/22/2008	4/17/08	5/22/08	8/1/2008
High St	at Cross St	Charlestown	Swap-Out, COB Light	2/22/2008	4/17/08	5/22/08	8/1/2008
Bunker Hill St	at Monument St	Charlestown	Swap-Out, COB Light	2/22/2008	4/17/08	5/22/08	8/4/2008
Medford St	at Tufts St	Charlestown	Swap-Out, COB Light	2/22/2008	4/17/08	5/22/08	8/1/2008
Terminal St	at Chelsea St	Charlestown	Swap-Out, COB Light	2/22/2008	4/17/08	5/22/08	8/1/2008
Tremont St	at Lowney Way	Charlestown	3rd party node (wood pole)	2/22/2008	4/17/08	5/22/08	7/22/2008
Pearl St	at Russell St	Charlestown	3rd party node (wood pole)	2/22/2008	4/17/08	5/22/08	12/12/2008
Mead St	at a pole 180 ft SW of Bunker Hill St	Charlestown	3rd party node (wood pole)	2/22/2008	4/17/08	5/22/08	7/22/2008
North Mead St	at Grant Court	Charlestown	3rd party node (wood pole)	2/22/2008	4/17/08	5/22/08	7/21/2008
Harvard Ave	at Commonwealth Ave	Brighton	Swap-Out, COB Light	5/23/2008	6/12/08	7/10/08	11/21/2008
Warren St	at a point 555 ft NW of Commonwealth /	Brighton	Swap-Out, COB Light	5/23/2008	6/12/08	7/10/08	9/19/2008
Colborne Rd	at Blenford Rd	Brighton	Swap-Out, COB Light	5/23/2008	6/12/08	7/10/08	9/5/2008
Corey Rd	at Washington St	Brighton	Swap-Out, COB Light	5/23/2008	6/12/08	7/10/08	10/15/2008
Glenville Ave	near the corner of Quint Ave	Brighton	3rd party node (wood pole)	5/23/2008	6/12/08	7/10/08	1/9/2009
Allston St	near Glenville Ave	Brighton	3rd party node (wood pole)	5/23/2008	6/12/08	7/10/08	8/19/2008

Corey Rd	at Kelton St	Brighton	3rd party node (wood pole)	5/23/2008	6/12/08	7/10/08	8/20/2008
Euston Rd	near Claymoss Rd	Brighton	3rd party node (wood pole)	5/23/2008	6/12/08	7/10/08	1/9/2009
Kilsyth RD		Brighton	3rd party node (wood pole)	5/23/2008	6/12/08	7/10/08	8/19/2008
Chiswick Rd	at Commonwealth Ave	Brighton	Swap-Out, COB Light	9/19/2008	9/25/08	10/9/08	11/21/2008
Sutherland Rd	200 ft SW of Englewood Ave	Brighton	Swap-Out, COB Light	9/19/2008	9/25/08	10/9/08	11/21/2008
Carol Ave	Pole # 1424/1	Brighton	3rd party node (wood pole)	9/19/2008	9/25/08	10/9/08	8/19/2008
Greenfield Rd	near Ridlon Rd Pole # 2037/16	Hyde Park	3rd party node (wood pole)	5/23/2008	6/12/08	7/10/08	8/11/2008
Ruskindale Rd	near Ralston St Pole # 1919/17	Hyde Park	3rd party node (wood pole)	5/23/2008	6/12/08	7/10/08	8/4/2008
Annafran St	near Cummins Highway Pole # 1293/2	Hyde Park	3rd party node (wood pole)	5/23/2008	6/12/08	7/10/08	8/5/2008
Taunton Ave	near Wood Ave Pole # 1920/1	Hyde Park	3rd party node (wood pole)	5/23/2008	6/12/08	7/10/08	8/5/2008
Edwardson St	near Wood Ave Pole # 6/1	Hyde Park	3rd party node (wood pole)	5/23/2008	6/12/08	7/10/08	8/5/2008
Bradlee St	near Crane St Pole # 313/15	Hyde Park	3rd party node (wood pole)	5/23/2008	6/12/08	7/10/08	7/23/2008
River St	near Massasoit St	Hyde Park	Swap-Out, COB Light	5/23/2008	6/12/08	7/10/08	10/17/2008
Canterbury St	at Hyde Park Avenue pole 245/1	Hyde Park	3rd party node (wood pole)	N/A	N/A	N/A	8/4/2008
Augustus Ave	at Crandall St	West Roxbury (6)	3rd party node (wood pole)	5/23/2008	7/24/09	8/7/08	12/3/2008
American Legion High	near Franklin Hill Ave Pole # 2304/390	West Roxbury (2) (JP)	3rd party node (wood pole)	5/23/2008	6/12/08	7/10/08	7/22/2008
Walk Hill St	at American Legion Highway Pole # 137	West Roxbury (2) (JP)	3rd party node (wood pole)	5/23/2008	6/12/08	7/10/08	8/21/2008
Eastland Rd	near Wayburn Rd Pole # 340/13	West Roxbury (2) (JP)	3rd party node (wood pole)	5/23/2008	6/12/08	7/10/08	7/23/2008
Neponset Ave	at Hyde Park Ave Pole # 1008/1	West Roxbury (2) (JP)	3rd party node (wood pole)	5/23/2008	6/12/08	7/10/08	8/21/2008
Eldridge Rd	200 ft W of Wachusett St	West Roxbury (2) (JP)	3rd party node (wood pole)	5/23/2008	6/12/08	7/10/08	8/21/2008
South St	at Asticou Rd Pole # 1380/29	West Roxbury (2) (JP)	3rd party node (wood pole)	5/23/2008	6/12/08	7/10/08	8/4/2008
Arborview Rd	300 ft NW of Malcome Rd	West Roxbury (2) (JP)	3rd party node (wood pole)	5/23/2008	6/12/08	7/10/08	9/15/2008
Driftwood Rd	at Mossdale Rd	West Roxbury (2) (JP)	3rd party node (wood pole)	5/23/2008	6/12/08	7/10/08	9/15/2008
Pond St	at Moss Hill Rd	West Roxbury (2) (JP)	3rd party node (wood pole)	5/23/2008	6/12/08	7/10/08	1/21/2009
Pond St	near the Jamaicaway	West Roxbury (2) (JP)	3rd party node (wood pole)	5/23/2008	6/12/08	7/10/08	10/27/2008
Perkins St	near Parkman Drive	West Roxbury (2) (JP)	3rd party node (wood pole)	5/23/2008	6/12/08	7/10/08	1/21/2009
Burnett St	at the bend on the S'ly leg	West Roxbury (2) (JP)	3rd party node (wood pole)	5/23/2008	6/12/08	7/10/08	12/4/2008
Williams St	near Forest Hills St Pole # 100	West Roxbury (2) (JP)	3rd party node (wood pole)	5/23/2008	6/12/08	7/10/08	5/7/2008
Olmstead St	near Peter Parley Rd	West Roxbury (2) (JP)	3rd party node (wood pole)	5/23/2008	6/12/08	7/10/08	9/10/2008
Walnut Ave	at Montebello Rd pole # 10	West Roxbury (2) (JP)	3rd party node (wood pole)	5/23/2008	6/12/08	7/10/08	8/13/2008
Woodman St	200 ft N of Jamaica St	West Roxbury (2) (JP)	3rd party node (wood pole)	5/23/2008	6/12/08	7/10/08	8/13/2008
Carolina Ave	at Carolina Place	West Roxbury (2) (JP)	3rd party node (wood pole)	5/23/2008	6/12/08	7/10/08	8/22/2008
Elm St	at Everett St	West Roxbury (2) (JP)	3rd party node (wood pole)	5/23/2008	6/12/08	7/10/08	5/21/2008
Starr Lane	at Centre St	West Roxbury (2) (JP)	3rd party node (wood pole)	5/23/2008	6/12/08	7/10/08	8/13/2008
Chestnut Ave	400 ft NE of Biltmore St Pole # 14/28	West Roxbury (2) (JP)	3rd party node (wood pole)	5/23/2008	6/12/08	7/10/08	8/22/2008
Boylston St	at Adelaide St	West Roxbury (2) (JP)	3rd party node (wood pole)	5/23/2008	6/12/08	7/10/08	9/3/2008
Sheridan St	at Cranston St Pole # 13/80	West Roxbury (2) (JP)	3rd party node (wood pole)	5/23/2008	6/12/08	7/10/08	8/13/2008
Washington St	at Stellman Rd	West Roxbury (2) (JP)	Swap-Out, COB Light	7/18/2008	7/24/08	8/7/08	9/30/2008
Forest Hills St	at South St	West Roxbury (2) (JP)	Swap-Out, COB Light	7/18/2008	7/24/08	8/7/08	9/25/2008
Green St	at Washington St	West Roxbury (2) (JP)	Swap-Out, COB Light	7/18/2008	7/24/08	8/7/08	9/30/2008
Boylston St	at Bismark St	West Roxbury (2) (JP)	Swap-Out, COB Light	7/18/2008	7/24/08	8/7/08	11/21/2008

School St	at Granada Park	West Roxbury (2) (JP)	Swap-Out, COB Light	7/18/2008	7/24/08	8/7/08	9/29/2008
Blue Hill Ave	at Seaver St	West Roxbury (2) (JP)	Swap-Out, COB Light	7/18/2008	7/24/08	8/7/08	11/20/2008
Centre St	at Orchard St	West Roxbury (2) (JP)	Swap-Out, COB Light	7/18/2008	7/24/08	8/7/08	8/22/2008
Centre St	at Greenough Ave	West Roxbury (2) (JP)	Swap-Out, COB Light	7/18/2008	7/24/08	8/7/08	8/22/2008
Centre St	at Spring Park Ave	West Roxbury (2) (JP)	Swap-Out, COB Light	7/18/2008	7/24/08	8/7/08	8/6/2008
Mozart St	at Lamartine St	West Roxbury (2) (JP)	Swap-Out, COB Light	7/18/2008	7/24/08	8/7/08	9/25/2008
Day St	200 ft S of Byner St	West Roxbury (2) (JP)	Swap-Out, COB Light	7/18/2008	7/24/08	8/7/08	11/17/2008
Perkins St	at the Jamaicaway	West Roxbury (2) (JP)	Swap-Out, COB Light	7/18/2008	7/24/08	8/7/08	9/29/2008
Parker Hill Ave	near Calumet St Pole # 172/5	Roxbury	3rd party node (wood pole)	7/18/2008	7/24/08	8/7/08	8/22/2008
Parker Hill Ave	near Fisher Ave Pole # 172/18	Roxbury	3rd party node (wood pole)	7/18/2008	7/24/08	8/7/08	10/27/2008
Cedar St	near Highland St Pole # 14	Roxbury	3rd party node (wood pole)	7/18/2008	7/24/08	8/7/08	not installed yet
Forest St	at Vine St	Roxbury	3rd party node (wood pole)	7/18/2008	7/24/08	8/7/08	9/4/2008
Moreland St	at Montrose St Pole # 10	Roxbury	3rd party node (wood pole)	7/18/2008	7/24/08	8/7/08	9/4/2008
Oscar St	at Terrace St	Roxbury	Swap-Out, COB Light	7/18/2008	7/24/08	8/7/08	9/22/2008
Centre St	at Estrella St	Roxbury	Swap-Out, COB Light	7/18/2008	7/24/08	8/7/08	10/29/2008
Washington St	at Malcom X Boulevard	Roxbury	Swap-Out, COB Light	7/18/2008	7/24/08	8/7/08	9/25/2008
Walnut Ave	at Circuit St	Roxbury	Swap-Out, COB Light	7/18/2008	7/24/08	8/7/08	11/24/2008
Blue Hill Ave	at Irwin St	Roxbury	Swap-Out, COB Light	7/18/2008	7/24/08	8/7/08	10/29/2008
Valentine St	at Washington St	Roxbury	Swap-Out, COB Light	7/18/2008	7/24/08	8/7/08	11/20/2008
Warren St	at Woodbine Rd	Roxbury	Swap-Out, COB Light	7/18/2008	7/24/08	8/7/08	10/29/2008
Walnut St	at Herrishof St	Roxbury	Swap-Out, COB Light	7/18/2008	7/24/08	8/7/08	9/22/2008
Washington St	at Columbus Ave	Roxbury	Swap-Out, COB Light	7/18/2008	7/24/08	8/7/08	not installed yet
Harold St	at Crawford St	Roxbury	Swap-Out, COB Light	7/18/2008	7/24/08	8/7/08	9/19/2008
Ruthven St	at Elm Hill Ave	Roxbury	Swap-Out, COB Light	7/18/2008	7/24/08	8/7/08	8/6/2008
Humbolt Ave	at Seaver St	Roxbury	Swap-Out, COB Light	7/18/2008	7/24/08	8/7/08	9/19/2008
Blue Hill Ave	at Warren St	Roxbury	Swap-Out, COB Light	7/18/2008	7/24/08	8/7/08	11/24/2008
Warren St	at Gaston St	Roxbury	Swap-Out, COB Light	7/18/2008	7/24/08	8/7/08	9/25/2008
Erie St	at Ellington St	Dorchester (3) (North)	3rd party node (wood pole)	7/18/2008	7/24/08	8/7/08	10/24/2008
Warner St	at Kingsdale St	Dorchester (3) (North)	3rd party node (wood pole)	7/18/2008	7/24/08	8/7/08	10/24/2008
Adams St	at Leonard St	Dorchester (3) (North)	3rd party node (wood pole)	7/18/2008	7/24/08	8/7/08	10/24/2008
Rosseter St	at Mallon Rd	Dorchester (3) (North)	3rd party node (wood pole)	7/18/2008	7/24/08	8/7/08	12/2/2008
Olney St	200 ft E of Everton St	Dorchester (3) (North)	3rd party node (wood pole)	7/18/2008	7/24/08	8/7/08	9/17/2008
Bellevue St	100 ft SE of Kane St	Dorchester (3) (North)	3rd party node (wood pole)	7/18/2008	7/24/08	8/7/08	9/17/2008
Ronan Park	200 ft E of Bellvue Ave	Dorchester (3) (North)	3rd party node (wood pole)	7/18/2008	7/24/08	8/7/08	9/17/2008
Cedar Place	300 ft W of Bird St	Dorchester (3) (North)	3rd party node (wood pole)	7/18/2008	7/24/08	8/7/08	8/21/2008
Massachusetts Ave	at Magazine St	Dorchester (3) (North)	Swap-Out, COB Light	7/18/2008	7/24/08	8/7/08	10/15/2008
Dudley St	240 ft NW of Folsom St	Dorchester (3) (North)	Swap-Out, COB Light	7/18/2008	7/24/08	8/7/08	10/17/2008
Howard Ave	at Hartford St	Dorchester (3) (North)	Swap-Out, COB Light	7/18/2008	7/24/08	8/7/08	10/8/2008
Quincy St	at Blue Hill Ave	Dorchester (3) (North)	Swap-Out, COB Light	7/18/2008	7/24/08	8/7/08	11/7/2008
Devon St	at Normandy St	Dorchester (3) (North)	Swap-Out, COB Light	7/18/2008	7/24/08	8/7/08	10/15/2008
Columbia Rd	at Washington St	Dorchester (3) (North)	Swap-Out, COB Light	7/18/2008	7/24/08	8/7/08	10/15/2008

Bradshaw St	at Esmond St	Dorchester (3) (North)	Swap-Out, COB Light	7/18/2008	7/24/08	8/7/08	10/8/2008
Washington St	at Park St	Dorchester (3) (North)	Swap-Out, COB Light	7/18/2008	7/24/08	8/7/08	10/9/2008
Greenbriar St	at Lindsey St	Dorchester (3) (North)	Swap-Out, COB Light	7/18/2008	7/24/08	8/7/08	1/17/2009
Geneva Ave	opposite Charles St	Dorchester (3) (North)	Swap-Out, COB Light	7/18/2008	7/24/08	8/7/08	1/26/2009
Geneva Ave	at Westville St	Dorchester (3) (North)	Swap-Out, COB Light	7/18/2008	7/24/08	8/7/08	10/14/2008
Geneva Ave	at Holmes St	Dorchester (3) (North)	Swap-Out, COB Light	7/18/2008	7/24/08	8/7/08	8/7/2008
Harvard Ave	opposite Claybourne St	Dorchester (3) (North)	Swap-Out, COB Light	7/18/2008	7/24/08	8/7/08	8/7/2008
Norwell St	at Vassar St	Dorchester (3) (North)	Swap-Out, COB Light	7/18/2008	7/24/08	8/7/08	11/20/2008
Mt Ida Rd	at Bentham Rd	Dorchester (3) (North)	Swap-Out, COB Light	7/18/2008	7/24/08	8/7/08	8/7/2008
Stonehurst St	at Norton St	Dorchester (3) (North)	Swap-Out, COB Light	7/18/2008	7/24/08	8/7/08	8/7/2008
Adams St	opposite Hendry St	Dorchester (3) (North)	Swap-Out, COB Light	7/18/2008	7/24/08	8/7/08	10/14/2008
Quincy St	at Columbia Rd	Dorchester (3) (North)	Swap-Out, COB Light	7/18/2008	7/24/08	8/7/08	11/20/2008
Sawyer Ave	at Downer St	Dorchester (3) (North)	Swap-Out, COB Light	7/18/2008	7/24/08	8/7/08	1/17/2009
Columbia Rd	opposite Cushing Ave	Dorchester (3) (North)	Swap-Out, COB Light	7/18/2008	7/24/08	8/7/08	10/17/2008
Harvard Ave	at Algonquin St	Dorchester (3) (North)	Swap-Out, COB Light	7/18/2008	7/24/08	8/7/08	11/4/2008
Pleasant Hill Ave	at Gallivan Boulevard	Dorchester (7) (South)	3rd party node (wood pole)	5/22/2008	5/22/08	6/12/08	8/1/2008
Manchester St	at # 193	Dorchester (7) (South)	3rd party node (wood pole)	5/22/2008	5/22/08	6/12/08	not installed yet
Morton St	at # 1005	Dorchester (7) (South)	3rd party node (wood pole)	5/22/2008	5/22/08	6/12/08	8/1/2008
Standard St	at # 100	Dorchester (7) (South)	3rd party node (wood pole)	5/22/2008	5/22/08	6/12/08	12/3/2008
Cragmore Terrace	at Ridgeview Ave	Dorchester (7) (South)	3rd party node (wood pole)	5/22/2008	5/22/08	6/12/08	8/1/2008
Cookson Terrace	at # 53	Dorchester (7) (South)	3rd party node (wood pole)	5/22/2008	5/22/08	6/12/08	8/21/2008
Wilcox Rd	at # 22	Dorchester (7) (South)	3rd party node (wood pole)	5/22/2008	5/22/08	6/12/08	8/20/2008
Dorchester Ave	at Dix St	Dorchester (7) (South)	3rd party node (wood pole)	5/22/2008	5/22/08	6/12/08	9/16/2008
Gibson St	near Adams St	Dorchester (7) (South)	3rd party node (wood pole)	5/22/2008	5/22/08	6/12/08	10/24/2008
Tilman St	300 ft W of Dorchester Ave	Dorchester (7) (South)	3rd party node (wood pole)	5/22/2008	5/22/08	6/12/08	8/20/2008
Ocean St	at # 32	Dorchester (7) (South)	3rd party node (wood pole)	5/22/2008	5/22/08	6/12/08	8/20/2008
Milton Ave	at Mora St	Dorchester (7) (South)	3rd party node (wood pole)	5/22/2008	5/22/08	6/12/08	12/2/2008
Norfolk St	near Capen St	Dorchester (7) (South)	3rd party node (wood pole)	5/22/2008	5/22/08	6/12/08	9/16/2008
Ferndale St	near Norfolk St	Dorchester (7) (South)	3rd party node (wood pole)	5/22/2008	5/22/08	6/12/08	9/16/2008
Oakhurst St	at # 32	Dorchester (7) (South)	3rd party node (wood pole)	5/22/2008	5/22/08	6/12/08	11/26/2008
Callender St	at # 99	Dorchester (7) (South)	3rd party node (wood pole)	5/22/2008	5/22/08	6/12/08	8/20/2008
Harvard St	1200 ft W of Walk Hill St	Dorchester (7) (South)	3rd party node (wood pole)	5/22/2008	5/22/08	6/12/08	7/23/2008
Itasca St	at # 31	Dorchester (7) (South)	3rd party node (wood pole)	5/22/2008	5/22/08	6/12/08	8/11/2008
Savannah St	at Newcastle St	Dorchester (7) (South)	3rd party node (wood pole)	5/22/2008	5/22/08	6/12/08	12/13/2008
Clementine Park	near Center St	Dorchester (7) (South)	3rd party node (wood pole)	5/22/2008	5/22/08	6/12/08	11/26/2008
Woodhaven St	at Cummins Highway	Dorchester (7) (South)	3rd party node (wood pole)	5/22/2008	5/22/08	6/12/08	8/21/2008
Butler St	near Adams St	Dorchester (7) (South)	3rd party node (wood pole)	5/22/2008	5/22/08	6/12/08	8/14/2008
Talbot Ave	at Blue Hill Ave	Dorchester (7) (South)	Swap-Out, COB Light	7/18/2008	7/24/08	8/7/08	10/8/2008
Harvard Ave	at Morton St	Dorchester (7) (South)	Swap-Out, COB Light	7/18/2008	7/24/08	8/7/08	1/21/2009
Mountain Ave	near Mascot St	Dorchester (7) (South)	Swap-Out, COB Light	7/18/2008	7/24/08	8/7/08	9/5/2008
Hillsboro Rd	at Wellington Hill Ave	Dorchester (7) (South)	Swap-Out, COB Light	7/18/2008	7/24/08	8/7/08	11/4/2008

Norfolk St	at Clarkwood St	Dorchester (7) (South)	Swap-Out, COB Light	7/18/2008	7/24/08	8/7/08	9/8/2008
Babson St	at Blue Hill Ave	Dorchester (7) (South)	Swap-Out, COB Light	7/18/2008	7/24/08	8/7/08	12/16/2008
Spencer St	at Wheatland St	Dorchester (7) (South)	Swap-Out, COB Light	7/18/2008	7/24/08	8/7/08	11/7/2008
Tremlett St	at Hooper St	Dorchester (7) (South)	Swap-Out, COB Light	7/18/2008	7/24/08	8/7/08	9/8/2008
Washington St	at Southern Ave	Dorchester (7) (South)	Swap-Out, COB Light	7/18/2008	7/24/08	8/7/08	10/9/2008
Armedine St	at bend	Dorchester (7) (South)	Swap-Out, COB Light	7/18/2008	7/24/08	8/7/08	8/6/2008
Fuller St	at Washington St	Dorchester (7) (South)	Swap-Out, COB Light	7/18/2008	7/24/08	8/7/08	12/5/2008
Dorchester Ave	at Gallivan Boulevard	Dorchester (7) (South)	Swap-Out, COB Light	7/18/2008	7/24/08	8/7/08	1/30/2009
Washington St	at River St/Dorchester Ave	Dorchester (7) (South)	3rd party node (wood pole)	7/18/2008	7/24/08	8/7/08	12/23/2008
Adams St	near King St	Dorchester (7) (South)	Swap-Out, COB Light	7/18/2008	7/24/08	8/7/08	9/30/2008
Florida St	at Edwin St	Dorchester (7) (South)	Swap-Out, COB Light	7/18/2008	7/24/08	8/7/08	9/30/2008
Radford Lane	at Bushnell St	Dorchester (7) (South)	Swap-Out, COB Light	7/18/2008	7/24/08	8/7/08	9/8/2008
Walk Hill St	near Wachusett St Pole # 1375/4	West Roxbury (2) (JP)	3rd party node (wood pole)	10/31/2008	11/6/08	11/20/08	12/24/2008